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P. A. Smith [a], C. Baber [a], J. Hunter [b] & M. Butler [c]

[a] Department of Electric, Electronic and Computer Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

[b] The Institute of Archaeology and Antiquity, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

[c] Centre for Forensic Investigation, University of Teesside, Middlesbrough, Tees Valley, TS1 3BA, UK

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P.A. Smith[a]*, C. Baber[a], J. Hunter[b] and M. Butler[c]

[a]*Department of Electric, Electronic and Computer Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK;* [b]*The Institute of Archaeology and Antiquity, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK;* [c]*Centre for Forensic Investigation, University of Teesside, Middlesbrough, Tees Valley TS1 3BA, UK*

The purpose of this study was to measure the team skills of operational crime scene examiners (CSEs). The techniques used were based on established methods and helped to gain a greater understanding of the domain of forensic investigation. The research begins with a hierarchical task analysis and then adapts pre-established methods for measuring the performance of CSEs in four UK Police Forces. The process supports comparison between prescribed methods of 'good practice' and real world practice. This has allowed the identification of the distributed skills and tasks of the CSE. Using Annett *et al.*'s HTA(T), crime scene examination can be categorised and the communications and coordination structures occurring between teams investigating a burglary considered. This makes it possible to generalise the method to situations involving ad hoc teams.

Keywords: crime scene examination; teamwork; hierarchical task analysis; police investigation

1. Introduction

This paper applies a method developed by Annett *et al.* (2000) for examining teamwork to the domain of crime scene examination. In Annett *et al.*'s (2000) study, the group being observed are undertaking training on the Principal Warfare Operators course and operate within the confines of a naval vessel, the tasks being measured occur in response to a defined trigger event (e.g. the presence of an enemy submarine) and the response of the crew is undertaken in line with a prescribed set of actions. Thus, their focus was on a team with defined roles working on a common problem in a shared environment. To some extent this could be considered as the archetypal definition of teamwork. In this paper, the method is applied to a different form of teamwork, which it is felt is becoming more prevalent in a range of domains, i.e. ad hoc teams.

There is a growing literature on ergonomics of teams, e.g. Salas *et al.* (2005), Burke (2006), Gorman *et al.* (2006), Walker *et al.* (2006). Rather than reviewing this literature, it is noted that there is less material published on task analysis of ad hoc teams. Annett and

*Corresponding author. Email: p.a.smith.1@bham.ac.uk

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Stanton (2000) note that what distinguishes a group of people from a team is: '. . .whether or not the members share a common goal, which they pursue collaboratively' (p. 1046). Pascual *et al.* (1999) conducted a questionnaire survey of military personnel to determine issues associated with distributed and ad hoc teams. This work suggested communications, situation awareness and leadership were particular issues affecting the team process. This implies that one way in which ad hoc teams differ from well-defined teams might be in terms of the cognitive demands of working to a shared understanding of the task domain and the actions required. In some instances, such as flying civilian aircraft, a 'team' might be formed on an ad hoc basis (i.e. the crew members are rostered to fly together and might only meet up on the day of the flight) but the training of the personnel ensures that procedures and knowledge will be common across members. In the Annett *et al.* (2000) study, team membership was essentially ad hoc (in that the participants were attending a course and had not necessarily worked together previously). However, one focus of the course would have been the development of these agreed procedures and knowledge of the domain. If it is not possible to apply agreed procedures and knowledge, then one might anticipate an increase in communications as the team members seek to develop their 'terms of reference'. Indeed, Stanton and Ashleigh (2000) observed teams in supervisory control and noted that new teams engaged in more information sharing than well-established teams. The implication is that the 'forming' of these teams involves an initial period of increased interaction, which could imply that ad hoc teams (by their very nature of being newly forming) could be expected to engage in a high level of communication. Thus, one hypothesis would be that ad hoc teams use communication in order to establish their procedures and understanding. From this point of view, one might expect to see relatively high 'teamwork' activity in ad hoc and less 'task-work' activity. However, if the 'task-work' is either very demanding or highly individualistic, then one might expect that the focus of 'team' members would lie in the performance of task work at the expense of teamwork. In other words, the members of the ad hoc team might not function as a team at all, but pursue their own activities. This state of affairs could be compounded by two factors, identified by Bushell (2004). First, the commitment of team members might be to their 'home group' rather than the team itself. Second, team members might be selected on the basis of their technical skills, which could lead to a specialist rather than collaborative culture within the team. In both cases, the emphasis would be on the individual performing to their own strengths (and seeing task work as the prime motivation for their work) and paying less attention to the performance of the team. From this initial discussion, the basic question that will be addressed is: How do crime scene examiners (CSEs) function as ad hoc teams?

1.1. Crime scene examination

Defining crime scene examination in terms of a team can be problematic, because several different 'teams' operate under the overarching premise of the criminal justice objectives. For example, CSEs operating within a particular geographical area or in a particular office work as a team and the membership of such a team will vary according to shift patterns and other duties. Similarly, CSEs involved in major crime will combine with other agencies as a team. The CSE will also work with personnel operating as part of the Criminal Justice System with a common objective to convict the guilty and reduce crime (Baber *et al.* 2006). These latter points are illustrated by Figure 1. In this diagram, the dotted ellipse represents agents that are typically involved in the investigation of a crime.

Notice that the CSE is separate from the police. This is because, although CSE is a criminal investigation function, it is typically (in the UK at least) staffed by civilian rather

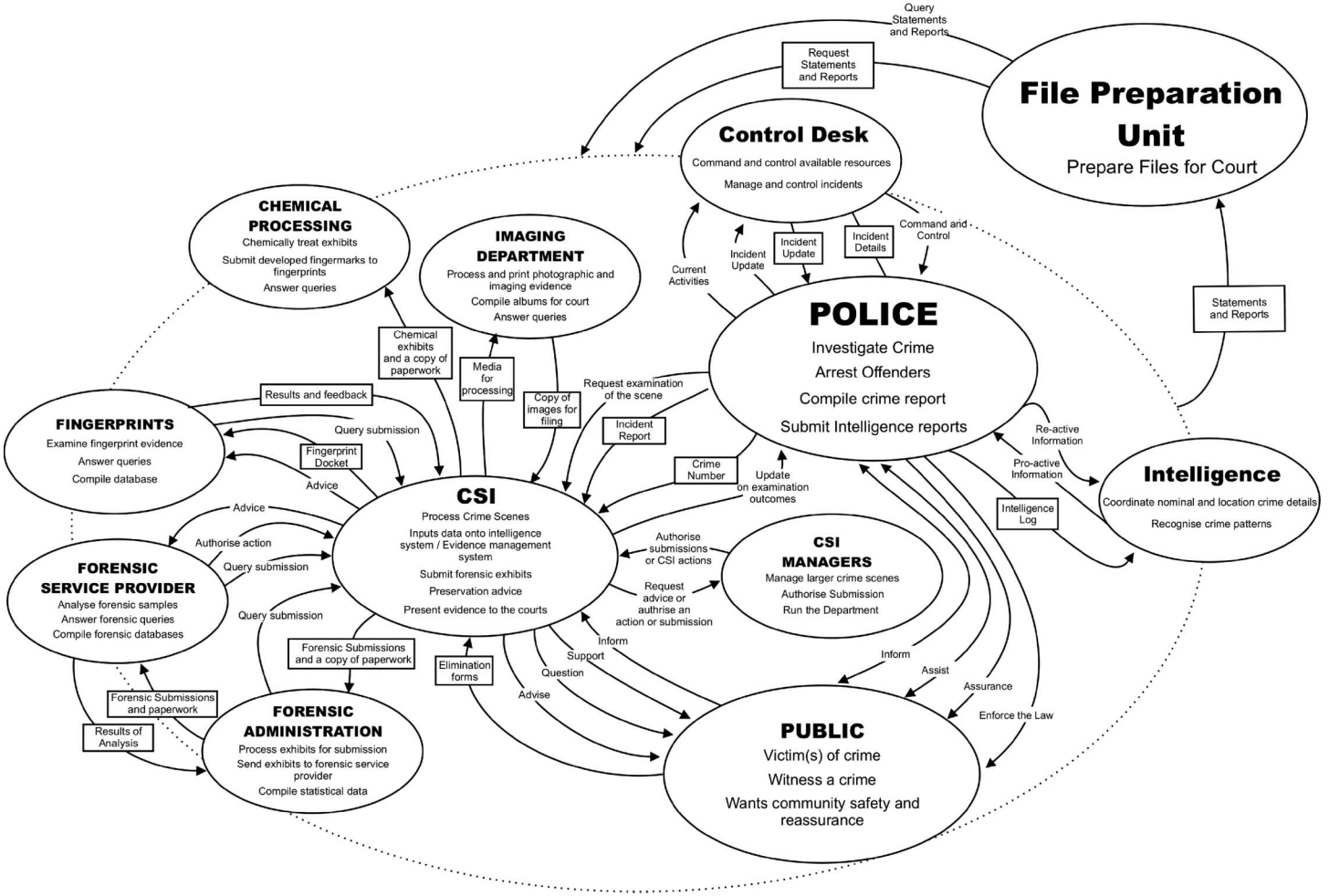

Figure 1. This diagram is based on the work flow model; it shows the responsibilities of each role and the interactions occurring between each one.

than police personnel. Figure 1 can be used to illustrate some of the 'teams' in which the CSE can become involved. The main crime scene examination 'team' typically revolves around a shift in which a crime scene manager allocates jobs to individual CSEs on a shift (typically three or four CSEs per shift depending on the police force). The work is usually performed on an individual basis, with each CSE attending a scene. However, the work involves the collation of information and evidence through consultation with different people. For example, at the start of an investigation there is a combination of people who help to define the initial details of the crime, e.g. its location, the nature of the crime, identification of victims, loss and damage, etc. This could involve the public, police, CSEs. As the investigation progresses, so the combination of people can change, perhaps to CSE, fingerprints, imaging department. As the investigation draws to a close then two combinations of people become active, i.e. a group who prepare a file for submission to the Crown Prosecution Service, e.g. File preparation unit, police, public, forensic service provider, CSE, and a group who develop a broader understanding of the nature of crimes in the area, e.g. intelligence, police, forensic service provider, CSE. The point of these examples is to illustrate that the CSE becomes temporarily a member of different groupings. Thus, criminal investigation depends on a network of skilled personnel who collaborate to establish the circumstances of a crime and identify the perpetrator. This is achieved through completing necessary sub-goals by following defined procedures, often by different individuals, and the communication of these sub-goals to other individuals in the process. The procedures produce a series of actions that should result in achieving the common goal. The effectiveness of achieving this goal is reliant on the efficiency of each process and the success of the communication and coordination between roles.

In this paper it is asserted that these temporary groupings can be considered 'teams', albeit ad hoc and transient instances of teams. There are two reasons why the authors wish to make such an assertion and to undertake the study reported. First, there are a growing number of domains (from military to emergency response systems to software engineering) in which ad hoc teams are formed in order to achieve a specific goal. The nature and performance of ad hoc teams can be assumed to be different from those involving teams that have 'formed, stormed and normed' over periods of time; these differences could be both affective (in terms of the sense of belonging and camaraderie of the team members) and cognitive (in terms of common experiences, training, knowledge of the team members). Second, the method developed by Annett *et al.* (2000) focused on a well-defined, tightly coupled team and the authors of this paper were interested in determining whether their approach could be generalised to these less tightly coupled, ad hoc teams. While the focus of this paper is on a specific domain, the resulting analysis and discussion can be generalised to other domains in which ad hoc teams are convened to achieve specific goals.

The primary focus of this work is on crime scene examination in volume crime. The term 'volume crime' refers to the most common crimes that require investigation, such as burglary, robbery or offences against the person excluding abduction or murder. Using the information represented in Figure 2, the agents involved in a typical investigation can be determined. The police call handlers receive the initial calls, the control desk manage the incident commanding and controlling field workers, the police officer attends and begins the enquiries into the incident, he/she sends and receives information from the control desk requesting, if necessary, any support services (including the CSE). This stage of the investigation is a reactive process of gathering and accumulating data, the measurable aspect of the team process is how effectively the information is communicated and how well the information is coordinated through the corresponding actions of the relevant agents. The primary medium for receiving information is via some form of operations system,

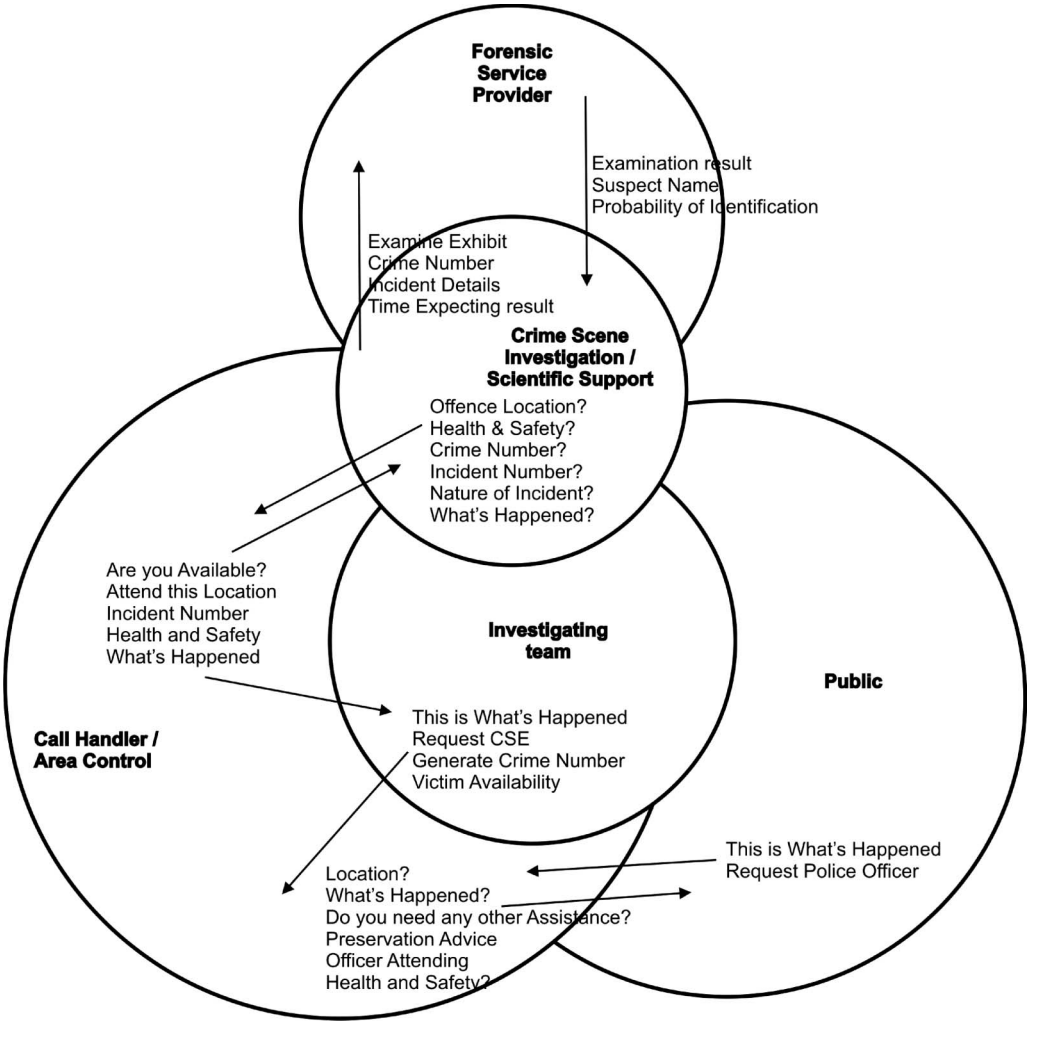

Figure 2. This diagram is based on Beyer and Holtzblatt's (1998, p. 90) cultural model; it is used here to illustrate the information requirements between stakeholders.

sometimes the CSE will be tasked via the radio, but this will still be logged on the incident log contained within the operations system. Similarly, when information is sent, this will be via the crime scene report and any exhibit labels, etc. For this study, the focus of teamwork is viewed from the perspective of the CSE, the information they require, the information they send and how the processes are coordinated. This is represented in Figure 2.

The team process model in Figure 3, adapted from Annett *et al.* (2000), highlights the team process variables, the relationships between them and the team product. The process of criminal investigation can be broken down into communication and coordination, cognitive processes and affective processes. Therefore, of interest is the communication and coordination, where information between the CSE and other agents in the process is sent and received. What is required is a measure of the team response defining the communication and coordination tasks that occur between the overarching team and how well these team process objectives are being met.

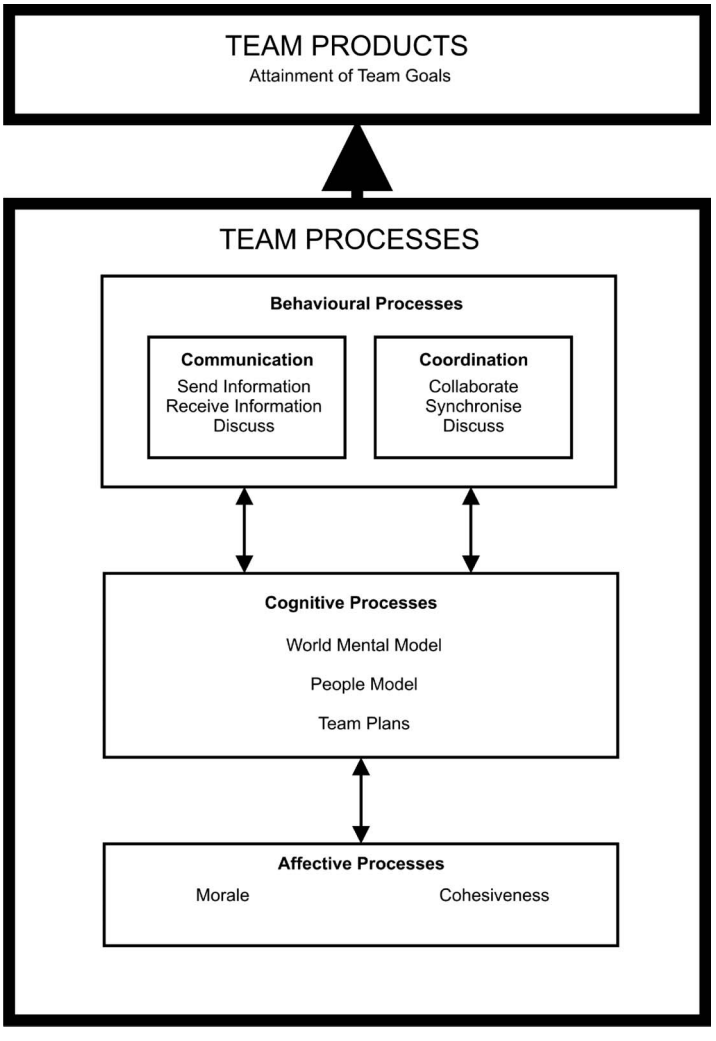

Figure 3. The team process model adapted from Annett *et al.* (2000).

1.2. Annett et al.'s (2000) method for measuring team skills

Annett *et al.* (2000) analysed team skills through specified training objectives and assessment of team performance. The participants in the study were trainees on an anti-submarine warfare training exercise, which is part of the Principal Warfare Officer course at the Royal Navy School of Maritime Operations. The aim of the Annett *et al.* study was to devise procedures for identifying team skills and develop a method for measuring team performance. Once they established a hierarchical task analysis for teams (HTA(T)), identifying the desired team output and the processes involved, they were able to establish the pertinent tasks and a method of recording and scoring team performance, allowing them to assess team skills. The HTA(T) methodology is used to identify sub-goals attained through teamwork, incorporating the communication and coordination ensuing between

members of the team(s). The analysis of the task is, therefore, crucial to identifying the measurable training objectives.

During the training exercise the trainees were observed, pertinent events noted and responses to those events recorded. The subsequent action of the trainee is based on a 'trigger event', in this case the emergence of an enemy submarine. The point of the exercise was to ensure that the correct responses were taken. There is a difference between Annett *et al*.' s use of 'trigger events' and how they are approached in this research. In the original Annett *et al*. study, the trigger events were introduced during a training exercise; the responses to the trigger events were monitored and evaluated. This means that the definition of the events and their introduction to the activity could be controlled within the study. In the study reported in this paper, the 'trigger event' emerges from the performance of the everyday work and, consequently, there is little control over their occurrence, nature or magnitude. However, in both instances, the 'trigger' can be classified as an occurrence that initiates a response. The activity of a CSE can trigger a response from others, e.g. they arrive at work and log on duty, this is noted by the operations system and highlights that the CSEs are operational. Looking at the activity in this way has helped the research team understand the triggers that occur within the context of the investigation. This is useful as it shows the interdependencies between the sub-systems and the significance of the goals and sub-goals to each activity. To the CSE this 'trigger event' requires attendance and an examination of a crime scene at the request of the officer; however, the request requires a series of actions and a thought process undertaken in relation to its nature. The Annett *et al*. (2000) method was useful in this context to understand the differences in practice and understand the investigative framework.

As defined by Annett *et al*. (2000) 'team members' combine efforts to reach a common goal. This is achieved through completing necessary sub-goals. For example, the goals of the investigation are to ascertain what has occurred and identify the perpetrator. The goal of the call handler (call taker) is to take the initial report from the victim, find out where the offence took place, give basic scene preservation advice, dispatch any emergency services, etc. This forms a system of sub-goals that produces information pertaining to the sequence of actions and is subsequently disseminated to the attending officer (and/or subsequent departments) who act on the information accordingly and utilise it to initiate the investigation. A basic example of the typical roles associated with the evolution of the investigation and the communication and artefact exchange is highlighted in Figure 1. Variables in operational process and work flow are observable, either through direct observation or through viewing an auditable record; of particular interest is the underlying behaviour and relevant working culture.

Annett *et al*.'s (2000) method for measuring team skills is applied to the domain of crime scene investigation. The intention is to identify real world practice and compare this to established standards of good practice. From this it should be possible to understand crime scene investigation, helping the research team to evaluate how future technologies can assist operational practicalities whilst fulfilling organisational demands across the Criminal Justice System. The aims of the study are:

- to identify the distribution of tasks used to investigate the crime
- to apply a quantifiable method to evaluate the differences between prescribed models of good practice and real world practice
- to use the information to devise novel methods of viewing crime scene work to facilitate future design.

2. Method

The methodology followed in this paper can be summarised as:

(1) Construct hierarchical task analysis (HTA) of domain.
(2) Classify tasks in terms of teamwork categories.
(3) Conduct observation of CSE work in the field.
(4) Compare observations with expected outcomes.

2.1. Construct task analysis of domain

In this study, HTA was employed. HTA re-describes the system into a hierarchy of goals and sub-goals, indicating at what point operations should be undertaken and helps identify system problems suggesting improvements (Annett *et al*. 1971, Kirwan and Ainsworth 1992, Shepherd 2001, Stanton *et al*. 2005). The HTA shown in Figures 4 and 5 highlights the response to a volume crime incident, in this case a burglary; in Figure 5 it has been used to describe the process of the scene examination. These HTAs are based on good practice as defined by the Home Office report *Skills for Justice* (2004), supported by the *ACPO Volume Crime Scene Investigation Manual* (ACPO 2001). This provides a description of expected performance. By drawing on the documents that outline desired and required procedures, the aim is to produce a de facto standard against which observed activity can be compared. Of course, crime scene investigation will be highly context- dependent and it would be foolish to assume that the procedures would be applied without modification to suit contextual demands. However, the manner in which the adaptation takes place and how the people performing the tasks communicate with each other will have a bearing on team performance.

In Figure 4, the primary goal is to investigate the crime. This incorporates the sub-goals of the involved practitioners. Within this HTA, the tasks are distributed; responsibility is spread across the associated groups. In Figure 5, the primary goal is that of the CSE, which is to examine the scene, the sub-goal may be taking photographs, writing descriptions, recovering exhibits, all of which play an integral part in exposing the potential information that the scene or specific exhibits may yield. An example of this is the label attached to the packaging containing the exhibit and its description on the crime scene notes. The exhibit may afford detection of an offender, but the label will highlight where the exhibit is from, the address, the condition, the time and date. This supporting information is vital to assist the forensic scientist in orientating the exhibit within the wider context of the investigation.

2.2. Classify tasks in terms of teamwork categories

Table 1 shows the primary and sub-goals (i.e. level X and X.x) from the task analysis outlined in Figure 5. Using methods suggested by Annett *et al*. (2000), the contents of each box can be examined under a series of headings. The goal identifies the desired end results, the measure reflects the 'criteria by which goal attainment can be judged' (ibid.). The communication looks at the agents with whom the CSE needs to communicate. The plan refers to the sub-goal and goal structure highlighting the order in which any sub-goals within the structure should be carried out.

Undertaking the sub-goal, and at what stage it should be carried out, is represented in Figures 4 and 5 by the number located in the left-hand corner of each box; for example, in

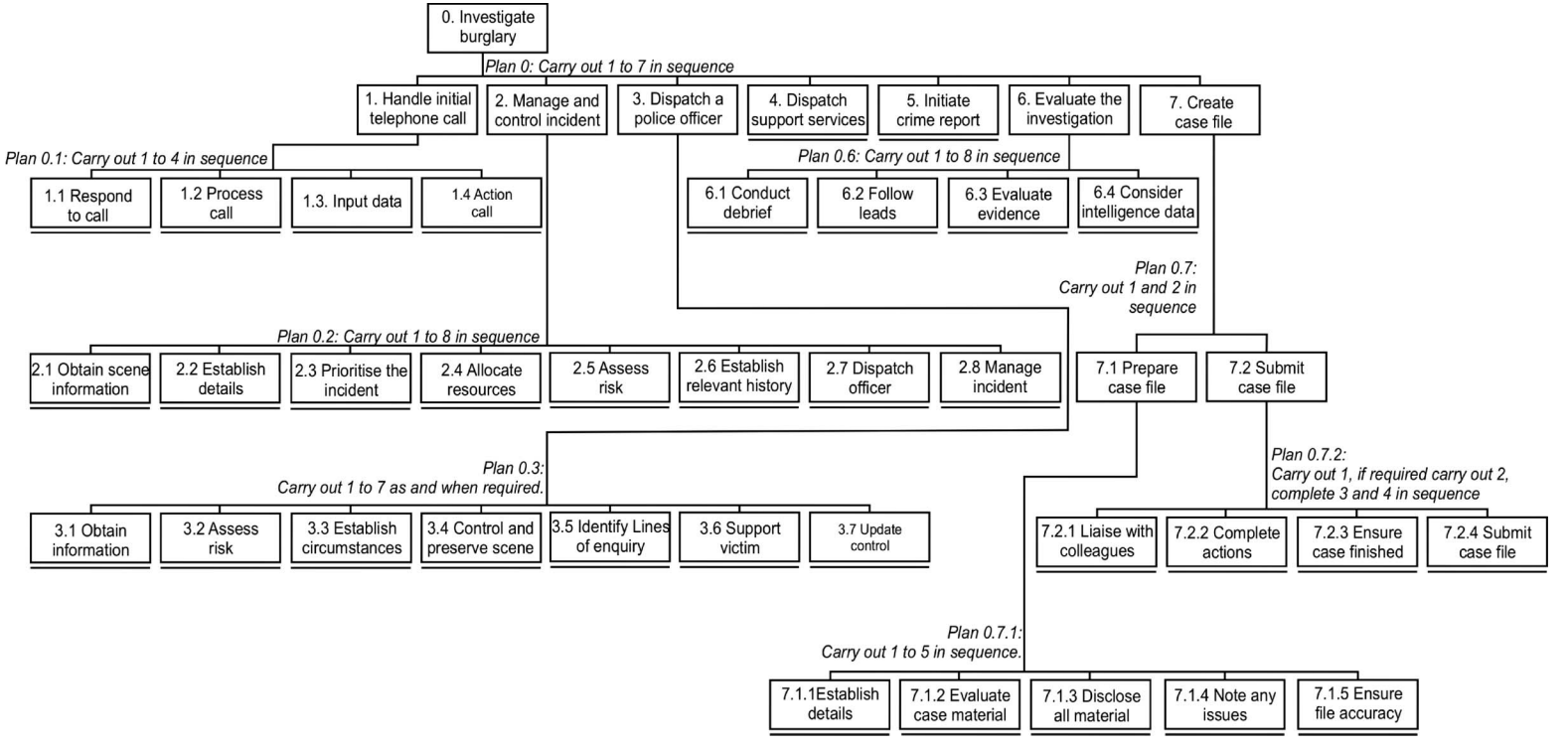

Figure 4. This hierarchical task analysis (HTA) gives a representation of the organisational responsibilities during a typical volume crime investigation.

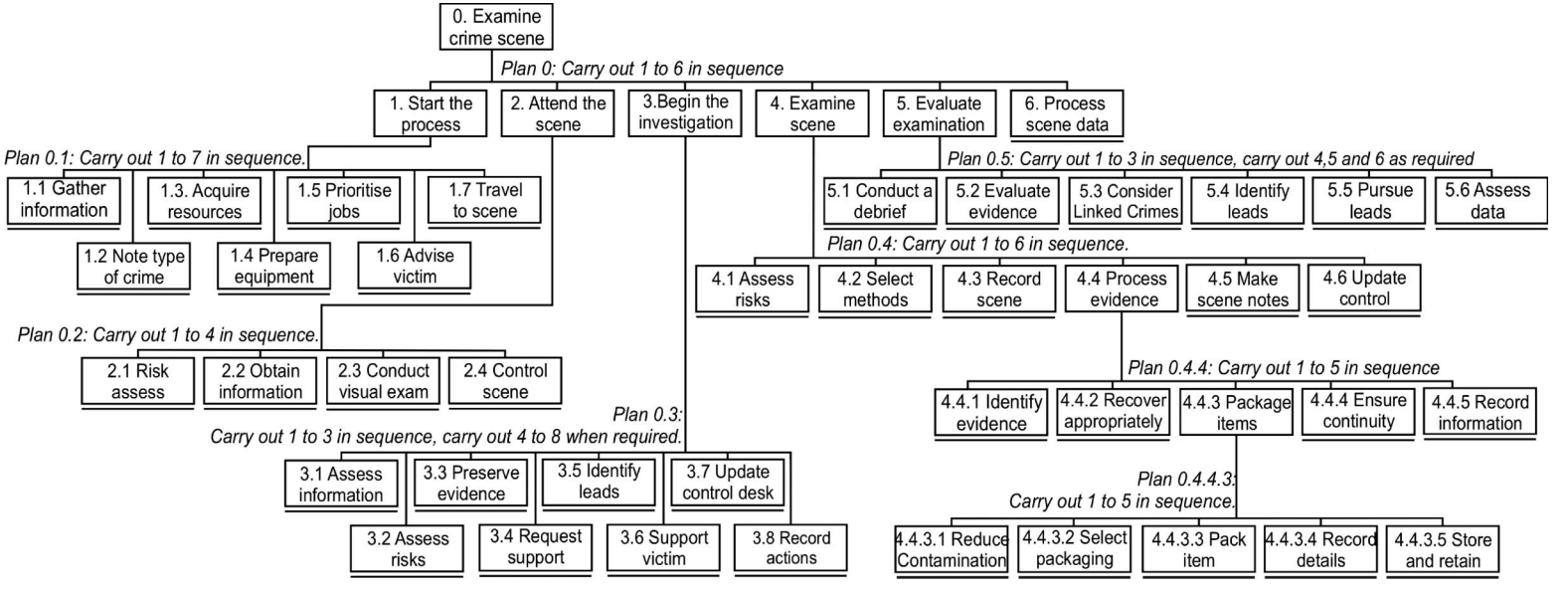

Figure 5. This hierarchical task analysis (HTA) gives a representation of the responsibilities of the crime scene investigator during a typical volume crime investigation. The HTA is based on the information contained within Skills for Justice.

Table 1. A description of the tasks that should be undertaken during a typical volume crime scene examination.

0. Examine a Crime Scene	
0.1 Start the Process	
Goal	Assess the incident requirements and prioritise workload
Measures	Sufficient, relevant information has been obtained from available sources, and an initial risk assessment has been conducted. The appropriate vehicle and equipment preparations have been completed.
Communications	Victims; Witnesses; Police Officers; Control Desk; Crime Scene Manager; Computer Systems
Plan	Tasks 1 to 7 carried out sequentially
0.2 Attend the Scene	
Goal	Obtain all available information from the scene
Measures	The CSE has arrived at the location, and secured the scene. The risk assessment has been updated and an initial walk-through of the scene completed.
Communications	Control Desk
Plan	Tasks 1 to 4 carried out sequentially
0.3 Commence the Examination	
Goal	Establish, identify and relay crucial information
Measures	The appropriate procedures, in terms of scene and crime, have been selected, and any witness or victim evidence has been collected.
Communications	Victims; Witnesses; Police Officers; Control Desk; Crime Scene Manager
Plan	Tasks 1 to 3 carried out sequentially; if necessary, tasks 4 to 8, monitor all tasks as they are performed
0.4 Examine the Scene	
Goal	Record scene and recover exhibits
Measures	The appropriate procedures have been applied to the crime scene and the recovery of exhibits, and detailed records produced in an appropriate format.
Communications	Crime Scene Examination Form; Exhibit Log
Plan	Tasks 1 to 6 carried out sequentially; if exhibit found, then tasks 4.4.1 to 4.4.5 sequentially; when packaging exhibit, 4.4.3.1 to 4.4.3.5 sequentially
0.5 Evaluate Scene Examination	
Goal	Review examination
Measures	The Crime Scene Examination Form and Exhibit logs are checked. The scene is given a final walk-through, and any other potential exhibits are considered. An initial selection of exhibit to submit is made.
Communications	Crime Scene Examination Form; Exhibit log
Plan	Tasks 1 to 3 carried out sequentially; tasks 4, 5, and 6 when required
0.6 Process Scene Data	
Goal	Process all paperwork and exhibits
Measures	Information from the Crime Scene Examination report (and any supplementary materials) is entered into relevant computer systems. Exhibits are passed to the Exhibit Clerk for dissemination to appropriate parties, e.g., forensic laboratories.
Communications	Crime Scene Examination Form; Exhibit Log; Computer Systems; Exhibit Clerk
Plan	Tasks 1 to 7 carried out in line with local policy

Figure 5, goal 0 is to examine a crime scene, this requires the completion of six sub-goals, including: 1) starting the process; 2) attend the scene; 3) conduct the investigation; 4) examine the scene; 5) evaluate the examination; 6) process scene data. The series of sub-goals should be undertaken sequentially; however, there are times when the order is altered depending on the circumstances. For example, if the scene is fingerprinted before forensic

evidence is recovered then the fingerprint methods used may interfere with the quality of the evidence. If the scene is photographed after exhibits have been recovered then the scene is not being recorded as it was found. This seems obvious, but there are occasions when the sequence is compromised, the precise order of recovery, as stated in goal 4.4 (Figure 5), is left to the interpretation of the CSE, matters relating to the nature of the scene and other actions may have an impact.

In Table 2 the process is separated into five categories: 1) receive information; 2) action (discussion); 3) send information; 4) collaboration; 5) synchronisation, following Annett

Table 2. Displays the measurement criteria in terms of coordination and communication, along with narrative, trigger event and resource for action.

Type	Action	Task / Team
Receive Information	*From Police systems/personnel:* -	
	• Note incident nature and logistics.	Task
	• Note any risk factors.	Task
	From victim/witness/scene: -	
	• Record nature of incident.	Team
	• Record Risk Factors.	Task
	• Identify Evidence sources.	Task
Actions/Discussion	*At the police station:* -	
	• Obtain all available information.	Team
	• Inform/update personnel.	Team
	• Prepare equipment.	Task
	• Prepare vehicle.	Task
	At the scene: -	
	• Question personnel.	
	• Conduct risk assessment.	Team
	• Conduct initial visual examination.	Task
	• Preserve vulnerable evidence.	Task
	• Record the scene.	Task
	• Collect evidence appropriately.	Task
	• Record all events.	Task
	• Evaluate scene examination.	Task
		Task
Send Information	*At the scene:* -	
	• Update control desk.	Team
	• Update Police officer.	Team
	• Update Scene information.	Task
	At the Police station: -	
	• Input Information into system(s)	Task
	• Forward/file documents.	Team
	• Distribute Evidence.	Team
	• Inform control desk.	Team
Collaboration	*At the Police station:* -	
	• Allocate Jobs.	Team
	• Discuss Problems with senior staff.	Team
	• Discuss Crime scene issues.	Team
	• Discuss Evidence submission.	Team
	At the scene: -	
	• Discuss Problems with senior staff.	Team
	• Discuss Crime scene issues.	Team
	• Consult Forensic providers.	Team
Synchronisation	Complete Scenes/paper work on time.	Team

et al. (2000). However, in order to align the categorisation with CSE, the observable actions and measurement criteria have been modified. The details of each section are explained below:

- Receive and send information: Much of the data accumulated during one event is consequential to the next. Therefore, this section tries to examine the information required and the way data are communicated during the course of the investigation.
- Action/discussion: The crime scene examination process is primarily one of collating information and exhibits. The actions relate to tasks performed in pursuit of this collation. Discussion between parties occurs throughout the investigation, information will be gathered from victim(s), witnesses, etc. through the appropriate action and will evolve to collaboration between the varying working groups, for example, police, scientific support, etc.

Table 3. Comparison of taskwork with teamwork activities (comprising sending and receiving information, discussion, collaboration and synchronisation).

Action	Send information	Receive information	Discuss	Collaborate	Synchronise	Task work
1		X				
2			X			
3						X
4			X			
5						X
6				X		
7			X			
8			X			
9						X
10						X
11						X
12						X
13			X			
14		X				
15	X					
16						X
17				X		
18						X
19	X					
20						X
21						X
22						X
23						X
24						X
25						X
26						X
27	X					
28				X		
29			X			
30				X		
31			X			
32						X
33						X
34						X
35	X					

- Collaboration: The forensic resource is dependent on adequately recovering exhibits to be examined by the forensic service provider. Thus, the process of crime scene investigation is based on the collaborative alliance between differing domain experts.
- Synchronisation: In order for the criminal justice system to function effectively, it is necessary for materials to pass through the system in a timely manner such that exhibits and information can be combined to form a case.

From this categorisation, it is possible to calculate the number of opportunities there might be for each type of action. This is shown in Table 3. The 'Type' headings are taken from Annett *et al.* (2000) to describe aspects of teamwork. The 'Action' headings are used to determine when an action is to be recorded. The 'Task/Team' column indicates whether an action is predominantly concerned with the achievement of a specific goal, i.e. task work, or whether it is concerned with sharing information and decisions, i.e. teamwork. One can see that the division of actions is fairly evenly split. Of the 35 items in the 'Action' column, 17/35 (48.6%) are related to different aspects of teamwork, and 18/35 (51.4%) are related to task work.

What this categorisation does not provide is any qualitative interpretation of the content of the information used in the different actions. Thus, if one considers the actions that fall under the general heading of discussion, there can be marked differences in the manner in which these actions are performed. Some of the discussion could relate to procedural matters, e.g. discussion of evidence submission could simply involve asking for the name and address of the desk officer to whom the materials should be sent, or it could relate to less broader issues, e.g. discussion of evidence submission could involve deciding whether an item could constitute evidence. The differences in these discussions could be represented partly in terms of time, e.g. is the discussion a discrete event (a question is asked and an answer given) or does the discussion consist of several discussions over a longer period of time (perhaps involving different agents providing different perspectives on the problem)?

2.3. Observe activity

The next stage required observing and measuring performance, by analysing the process in terms of the tasks, the 'trigger events' and subsequent actions, and comparing this against the proposed activity from the HTA. Observing these differences (between expected and observed activity) can be used to evaluate the process in terms of necessary tasks, the desired goals and the elements where technology can be used to support it. Annett *et al.* (2000) state that it is 'not what is or is not achieved, it is how the work is carried out'.

Individual CSEs from four police forces were accompanied for a single working day each. The analyst arrived at work at the same time as the CSEs did and observed the tasks undertaken throughout the day. Contemporaneous notes of the activities were recorded in terms of the goal level activities defined by the HTA. Thus, the process followed was a form of activity sampling, in which the start and end time of primary activities were logged. Due to the nature of the observation, it is not possible to record inter-rater reliability measures, but the observation logs for each day were reviewed by the analyst and the CSE to ensure that it was a fair report of how they had spent their day. The CSEs were based at local policing units distributed in rural locations and in urban centres across four police forces. Within this paper, the same methodology has been used during all the sessions. The observations were conducted whilst operational at volume crime scenes and whilst they were undertaking clerical work.

Information relating to the crime scene request is received by the CSE. The requests are delivered via an electronic or fax message (there are occasions when the CSE is requested by word of mouth or via the radio). The messages contain details of the address, relevant times and dates, the officer dealing with the incident and relevant beat and system numbers. The message also contained details of the incident or modus operandi. When registered on duty the officer is recorded on the operations system, for reasons of health and safety, logistics and operational practicality. The volume crime scenes to be visited that day are distributed amongst the CSE.

The allocated scenes are examined consecutively. During the four sessions, between one and three scenes were examined over the course of the shift. The shifts are typically of 8-h durations, including lunch breaks, and the observed activities took approximately 60% to 75% of the shift. Table 4 lists the scenes examined for each CSE, together with each job type per CSE, also observing the time it took the CSE to: 1) travel to the scenes and back; 2) the time taken examining the scenes; 3) the time it took them to complete the relevant paperwork. The geographical location of the CSE may have significance to travelling time so the authors of this paper have highlighted whether each CSE is located in an urban or rural setting.

Central to the investigative process is the information sent and received along with the detail of that information. Of particular interest is whether the data received meet the minimum operational requirements of the CSE. For example, basing the analysis on Table 2, when the narrative is received by the CSE, in terms of the request to attend

Table 4. This table shows a break down of each CSI and the jobs they attended throughout the day. The crimes appearing in bold denote the jobs which were used to apply Annett *et al.*'s methods.

		Time (in minutes): 1. Travelling 2. At the Scene 3. Relevant paperwork		
CSI	Job	1	2	3
	1. Burglary to a Civic Centre	**54**	**56**	**18**
CSI 1 (Rural)	2. Burglary to a Retail Store	13	43	10
	3. Burglary to a Dwelling in a Rural Location	40	10	1
	Office Paperwork			137
	Total	107	109	166
	1. Burglary to a Building site	**23**	**52**	**12**
CSI 2 (Urban)	2. Burglary to Dwelling in an Urban Location	21	23	7
	3. Burglary to a Nursery School	25	45	15
	Office Paperwork			86
	Total	69	120	120
CSI 3 (Urban)	1. Burglary to Disused Council Building	10	35	10
	2. Burglary to a Dwelling in Suburban Location	**5**	**55**	**15**
	3. Burglary to a Dwelling in Urban Location	10	36	14
	4. Burglary Other than Dwelling at Urban Location	15	31	10
	Office Paperwork			70
	Total	40	157	119
CSI 4 (Rural)	**1. Stolen HGV**	**26**	**46**	**20**
	Office Paperwork			68
	Total	26	46	88

the scene, there is certain data crucial to the scene exam. Appendix 1 highlights these data.

3. Results

In this section, the main focus of the analysis will be on behavioural processes. These will be defined by the data acquired through observation. A shorter section will explore the cognitive processes, through a general model of information flow. Of particular relevance to this work is the concept of 'narrative', which defines the way in which information received at different stages in the investigation can be assimilated into an ongoing account of the 'crime'. This latter concept is explored in more detail in the conclusions section, as are implications for the affective processes.

3.1. Behavioural processes

The CSEs were observed whilst undertaking the various tasks at each stage. Appendix 2 highlights the results of these observations. The observations indicate that 'Send information' occurs fewer times than expected. This implies that the CSEs tend not to engage in formal reporting from the scene but prefer to compile reports for dissemination after the examination of a scene. 'Receive information', 'Collaborate' and 'Task work' occur at rates that these authors feel indicate that the opportunity to engage in these activities will vary across situations and that CSEs adapt their practices to suit the scene, i.e. they do not necessarily follow all steps in a procedure if those steps are not relevant to that scene. This suggests that procedural compliance will be adapted to contextual demands. On the other hand, 'Discuss' scores highly in this analysis. This can be taken in support of the earlier assertion that CSEs can be considered as members of ad hoc teams and suggests that informal sharing of information is an essential aspect of their work.

Throughout the day there will be circumstances occurring and impacting on the tasks undertaken. In most cases, failure to perform the prescribed tasks is not done in error, it is practice adapted through the experience, or through an element, which they see, constraining the examination. For example, action 12 (Appendix 1) relates to contemporaneous notes: CSEs 1, 2 and 3 tended to complete their notes away from the scene, because they needed space and time to concentrate on the notes without disruption. On some occasions they are disturbed and unable to complete the notes in a timely manner. CSE 4 highlighted that though laptop computers have been issued, they are not routinely taken to the scene. Rather, handwritten notes are made at the scene and the electronic versions are completed later.

Problems regarding the clerical and bureaucratic responsibilities of the police and police staff is not a new issue, with the investigative task comes the need to document and record actions and data for a number of different purposes. Appendix 3 confirms the imbalance between time spent at the scene and time spent on other clerical duties. For example, of the CSEs observed, 44% of their time was spent on clerical matters, involving, in many instances, duplicating the same information; this can be compared to 37% of time spent actually examining the scene. Out of the 35 actions outlined in Appendix 1, four are concerned with clerical duties, i.e. around 11%. This implies that 44% of their working time is spent on tasks that constitute 11% of their total activity. Obviously, deductions from proportionality cannot be assumed in this manner, but the exercise has successfully outlined the pertaining issues that affect the practicalities of the CSE, as well as the issues pertinent to the needs of the organisation.

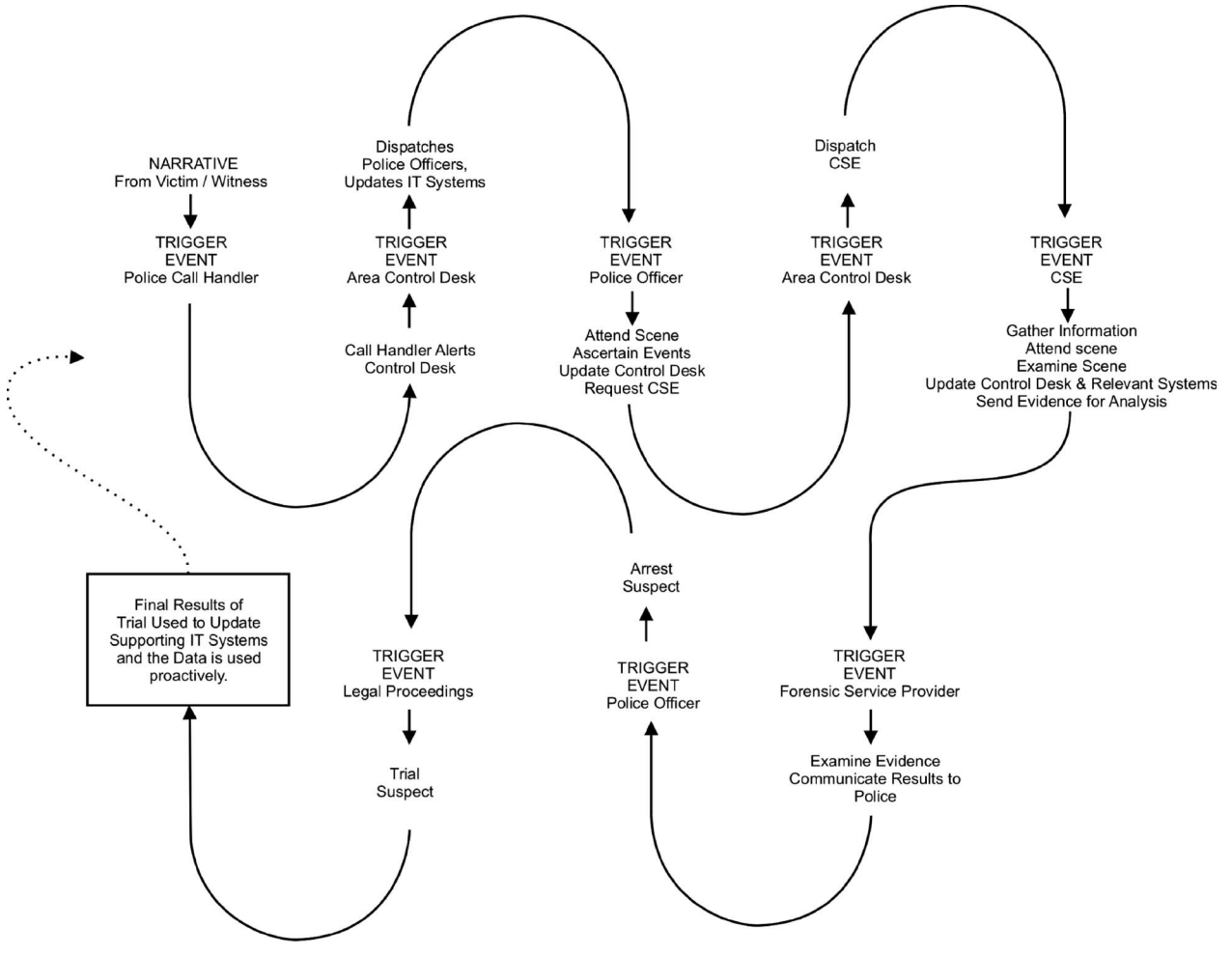

Figure 6. This diagram shows how the narrative develops throughout the investigation.

3.2. Cognitive processes

The behavioural processes have been interpreted as opportunistic teaming in an ad hoc manner. This would appear to be at odds with more formal notions of teams and command structures. While the CSE is managed by a crime scene manager, the nature of the work demands a high degree of autonomy. The reporting process requires the production of a crime scene report to be fed into the Criminal Justice Systems team. However, it is noted that the various discussions give rise to another form of information sharing, which is termed narrative development. This is reflected in the classification under the heading Actions (Discussion). Figure 6 shows how various accounts of an incident are captured and how the exchanges of these narratives form trigger events for much of the activity. Presumably in situations where a narrative is incomplete, ambiguous or contradictory, effort will be put into constructing an appropriate level of detail in order to evoke the next trigger event. If this is plausible, then three hypotheses follow. First, the discussion activity engaged in by the CSE can be seen in terms of narrative development to help advance the investigation to the next trigger event. Second, the production of material for use outside the immediate progression of the process might be seen as an intrusion. Third, the structure of the CSE's own 'narrative' could have a bearing on what information could be collected and reported, e.g. by placing much of the effort of collecting evidence from point of entry, a CSE might assume that this is where the criminal would leave significant evidence for recovery.

3.3. Affective processes

The study did not formally collect information relating to attitudes to work, but these issues were gathered through interview and discussion with respondents. The primary issues raised related to the burden of paperwork and the sense that this intruded on examination of the crime scene. To some extent, this complaint arose from a lack of understanding of the uses to which some of these data were later put, e.g. in terms of crime scene management or in terms of intelligence.

4. Discussion

The information could be referred to when it was tabulated, highlighted in Appendix 3 and it was easily identified enabling the observer to recognise actions requiring further investigation, of particular interest are occurrences of shared deviation from recommended practice. Appendix 3 exhibits some of these process alterations. For example, actions 12, 30 and 34, within these actions the CSE have not completed the action as prescribed. These actions relate to completing crime notes contemporaneously, and doing further intelligence work. Within these tasks, all the participants deviated from prescribed practice showing a commonality in divergence. This shared adaptation of tasks could be indicative of a common issue impacting on the task execution of the CSE.

4.1. Comments on Annett et al.'s (2000) HTA(T)

Although crime scene investigation and naval operations represent different contexts, the response to a 'trigger event' is similar, in that a specific occurrence prompts a particular response; in regard to CSE, the type of response is governed by the nature of the 'trigger event'. Some 'trigger events' require an immediate action, whereas others can be deferred

until an opportune moment. For example, the recovery of an exhibit from a crime scene should be a trigger event to complete a contemporaneous record. However, some of the CSEs preferred to collect and bag exhibits at the scene before moving to another location (such as their van) before writing the notes and labels. This suggests that the association between a trigger event and an action could involve some intervening tasks. There are prescribed methods adopted; however, the CSE has an inherent flexibility that is dependent on individual or team interpretation. The usefulness of the method described by Annett *et al*. is that it successfully provided methods to assess the extent to which CSE teams adhere to prescribed methods and where practice flexibility occurs.

The application of this method allowed focused observations and a quantifiable method to evaluate practice. This exhibited matters prevalent to both the organisation and the people performing the tasks, for example, some of the data recorded at the scene are required for statistical purposes at the behest of the organisation, whereas the CSE uses the data to inform and facilitate the investigation. The statistical information is required for many purposes, the collation and inputting of this information is either performed through a laptop computer at the scene or by transcribing scene notes into a system back at base. The problem with collating this information is that it impinges on scene examination time; consequently, the clerical responsibilities were an area exhibiting commonality in deviation. Where adaptation or deviation occurred within the process, the methodology used allows the reasons to be explored quickly and specifically.

This research has taken an established method to measure team performance, adapted it slightly and used it successfully to examine the real-world practicalities of crime scene investigation. The method has provided a quick and easy tool for analysing the criminal justice domain and has produced many interesting questions requiring further investigation, which will help guide future technologies for crime scene investigation. Construction of the HTA took around 3 d, based on the standard procedures consulted and the experience of the author P.S. and the observation reports were completed during the working days of the CSEs. Comparison between the HTA descriptions and the observations took around 1 d for each of the observations. The most time-consuming aspect of the work was gaining access to the different CSEs and agreeing days on which they could be observed. HTA(T) has helped the design team to recognise the tasks inherent to CSE practice and the communication/coordination required throughout the criminal justice process at a volume crime.

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Appendix 1. Summary of tasks.

Action No.	Action	Goal Number	Observed
When a job request is received, carry out 1 to 7.			
1	Note the incident nature and logistical information.	1.1	
2	Read/listen to all information available on the incident.	1.1	
3	Note if there are any risk factors present.	1.2	
4	Inform and update relevant personnel.	1.6	
5	Assess and prepare relevant equipment and conduct vehicle checks.	1.4	
6	Prioritise workload in collaboration with other examiners.	1.5	
7	Discuss any issues with senior staff (if required).	1.6	
If victim or appropriate person is present, carry out 8 to 13. If there is no reply, leave appropriate contact details and move on to next job and restart at 1.			
8	Question anybody present on the events surrounding the incident.	2.2	
9	Ascertain whether there are any risk factors and take measures to maintain health and safety.	2.1	
10	Identify the presence of potential evidence, assess whether it is at risk of contamination and take the necessary steps to protect it, redefining the scene parameters if necessary.	2.3	
11	Assess the need for any additional resources and equipment.	2.3	
12	Begin the crime scene notes recording any apparent details of relevance to the incident.	2.3	
13	Explain the examination process to the victim/witness if necessary gain consent.	2.4	

(*continued*)

Appendix 1. (*Continued*).

Action No.	Action	Goal Number	Observed
If there is information prevalent to the incident and the subsequent investigation, carry out 14 to 17. If there is no relevant information, move to 18.			
14	Assess the information received or uncovered.	3.1	
15	If required request additional support or information.	3.2	
16	Document and record all uncovered information.	3.8	
17	Inform the relevant personnel of any uncovered information which could have a bearing on the investigation.	3.7	
If the scene is contained and evidence is well preserved, move to 22. If the scene is outside or there is risk of contamination, carry out 18.			
18	Review and define the scene parameters.	3.3	
19	Request additional assistance and instruct others on the scene preservation issues.	3.4	
20	Use appropriate measures to protect potential evidence.	3.3	
21	Monitor the scene and protect vulnerable evidence.	3.3	
Once all the required information has been gathered begin the scene examination, carrying out 22 to 28.			
22	Appropriately record the scene and any uncovered evidence.	4.3	
23	Determine the sequence of the examination and the types of procedures to use.	4.2	
24	Select the appropriate health and safety precautions according to the evidence being recovered.	4.1	
25	Select the correct techniques to recover the evidence.	4.2	
26	Ensure that all evidence is collected and packaged in accordance with the forensic service provider's guidelines.	4.4.3	
27	Record all the information relating to the scene examination contemporaneously.	4.5	
28	Maintain contact and inform relevant personnel of examination progress when necessary.	4.6	
If the examination is complete, carry out 29 to 30. If there are further scenes requiring an examination return to 22.			
29	Conduct a final walk through of the scene and de-brief the victim/witnesses.	5.1	
30	Evaluate the gathered evidence and identify any further requirements, if possible/required, de-brief the police officer in charge of the investigation.	5.2	
If the examination is complete, carry out 31. If there is further work to do at the scene return to 22			
31	Give advice to the victim/witness on any issues, gather any elimination material and finish the scene.	5.1	
If any crimes left to examine, travel to next job and restart process at 1. If all jobs are completed, travel back to the station, move on to 32.			
32	Evaluate the gathered evidence and decide on an adequate submission policy for each incident.	5.2	
33	Conduct further examination of the evidence if required.	5.4	
34	Consider the possibility of any linked incidents and if necessary complete an incident log.	5.3	
35	Process the paperwork, update systems and disseminate the evidence for further examination.	6	

Appendix 2. Samples of observed activity.

Time	Event	Response
CSE 1		
07:28	Start of the process: *Examination requests*	The incident requests were received and scrutinised, noting the nature of the incident and listing all the information available. The information regarding the incident was recorded into the relevant system and required equipment was put together, however, no vehicle check was carried out. Crime scene examiner (CSE) 1 travelled to the first job.
09:11	Attend the scene: *Information from scene personnel*	CSE 1 met with police officers at the scene and began the process of gathering relevant information. No visible risk assessment was carried out; however, some precautions were taken, by some protective equipment. There were glass fragments left outside which had not been placed inside to dry, CSE 1 noted this and mentioned it to the personnel present. On two occasions the CSE had to return to the vehicle to collect packaging or presumptive testing kits. No notes were taken at the start of the examination and the site representative was only partially informed of the examination parameters.
09:28	Examine the scene: *Evidence present at the scene*	The scene was not photographed, but in line with force policy written notes were made at the end of the examination after the process was completed. Forensic evidence was recovered first, including glass and apparent blood; this was followed by a fingerprint exam, which identified footwear marks and several fingerprints. All the evidence was recovered according to recovery policy. Relevant protective equipment was worn throughout the exam. The crime scene notes were written at the end of the process, whilst the CSE was still within the scene. No contact was made with the site authorities until the end; however, a full briefing then took place.
10:07	Evaluate the scene examination: *Scene findings*	The final walk through was only undertaken in one room, the evidence was partially evaluated and the police officer in charge was not notified of the scene findings at this point.
10:15	Evaluate the scene examination: *Need for elimination prints and end the scene examination.*	The site officer received advice relating to cleaning the fingerprint powder, etc. Elimination fingerprints were taken. CSE 1 finished scene 1.
CSE 2		
08:10	Start of the process: *Examination requests*	Requests received, the printed incidents were read, but no relevant system was viewed to gain up-to-date information. There were risk factors present, which were highlighted in the incident, and these were noted by CSE 2. The relevant people were contacted, contacting the site manager of the first job and arranging an appropriate time to visit. The appropriate equipment was prepared; however, no vehicle checks took place. The work load was appropriately prioritised before CSE 2 travelled to the job.
08:53	Attend the scene: *Information from scene personnel*	CSE 2 met with the site manager and gathered all the information available. Although the risk factors were noted (the scene was a building site) no hard hat was worn. Appropriate measures were taken to identify potential evidence and ensure its preservation. The scene was assessed

(*continued*)

Appendix 2. (*Continued*).

Time	Event	Response
		as to what resources were required; however, the CSE still had to return to the vehicle for additional equipment. CSE 2 did not commence the crime scene notes until after the examination. The site manager was fully informed of the examination parameters.
09:07	Examine the scene: *Evidence present at the scene*	The scene parameters were reviewed, the area of the site requiring examination was used as a canteen and, therefore, CSE 2 asked the site workers to have a coffee break elsewhere. The scene was appropriately recorded and the appropriate methods were employed to gather and package the evidence. Health and safety procedures were partially carried out and the crime scene notes were not carried out contemporaneously.
09:39	Evaluate the scene examination: *Scene findings*	The scene was evaluated and the gathered evidence was prioritised appropriately.
09:46	Evaluate the scene examination: *Need for elimination prints and end the scene examination.*	Appropriate measures were taken to gather elimination fingerprints and the site manager was informed of the results of the examination.
CSE 3		
07:17	Start of the process: *Examination requests*	All the requests were received and inputted to the relevant systems, up-to-date incidents were read and any present risks were highlighted and, in one case, previous violent history on an address was checked and established that it was not applicable. The relevant equipment was gathered, but no vehicle checks were carried out.
10:04	Attend the scene: *Information from scene personnel*	All the parameters were undertaken in line with good practice; however, the crime scene report was not carried out at the scene, but it was compiled whilst the CSE was in the vehicle.
10:12	Examine the scene: *Evidence present at the scene*	The correct procedures were used to record locate and recover the evidence; however, the adequate health and safety procedures were not followed. Furthermore, the scene report was not compiled contemporaneously.
10:45	Evaluate the scene examination: *Scene findings*	The final walk through was completed and the collected evidence was evaluated; however, there were procedures that could have been undertaken at the scene but the items were packaged and taken back to the police station.
10:57	Evaluate the scene examination: *Need for elimination prints and end the scene examination.*	Some of the evidence recovered required further examination, but the items were packaged to be examined later. No intelligence checks were carried out on return to the office. The paperwork was only partially completed.
CSE 4		
11:00	Start of the process: *Examination requests*	The vehicle was linked to other crimes and subsequently the police officer dealing was very interested and remained in contact with CSE 4. All relevant information was gathered, and relevant equipment was prepared; however, the vehicle checks were not done.
11:30	Attend the scene: *Information from scene personnel*	The police officer in charge constantly updated CSE 4 of the related incidents as they developed, and the CSE noted and used that information. The scene was evaluated and

(*continued*)

Appendix 2. (*Continued*).

Time	Event	Response
		appropriate measures were used. CSE 4 had to return to his vehicle a number of times to collect additional equipment. The notes were commenced at the time and were taken contemporaneously throughout. However, at this particular force, laptop computers should be used at the scene, on this occasion notes were used, which the CSE was going to input at a later time.
11:35	Examine the scene: *Evidence present at the scene*	CSE 4 updated the police officer in charge regarding the items within the vehicle. The scene was examined to good practice guidelines; however, appropriate health and safety equipment in relation to the techniques undertaken was not worn.
12:20	Evaluate the scene examination: *Scene findings*	At this point the CSE was called to a serious incident, which affected the scene evaluation. The scene was complete, but the evaluation was not carried out.
12:45	Evaluate the scene examination: *Need for elimination prints and end the scene examination*.	CSE 4 attended a serious incident, which meant much of the paperwork process was not carried out; the police officer dealing was informed of the outcomes by phone.

Appendix 3. Summary of the observations of the crime scene examiner (CSE) response to the trigger events.

	CSE 1	CSE 2	CSE 3	CSE 4
Actions 1–7				
1	2	2	2	2
2	2	1	2	2
3	2	2	2	2
4	2	2	2	2
5	1	1	1	1
6	2	1	2	2
7	2	2	2	2
Total (out of 14)	13	11	13	13
Actions 8–13				
8	2	2	2	2
9	1	1	2	2
10	2	2	2	2
11	1	1	2	1
12	0	0	0	2
13	1	2	2	2
Total (out of 12)	7	7	10	11
Actions 14–17				
14	n/a	n/a	n/a	2
15	n/a	n/a	n/a	2
16	n/a	n/a	n/a	2
17	n/a	n/a	n/a	2
Total (out of 8)				8
Actions 18–21				
18	n/a	2	n/a	n/a
19	n/a	2	n/a	n/a
20	n/a	2	n/a	n/a
21	n/a	2	n/a	n/a
Total (out of 8)		8		
Actions 22–28				
22	2	2	2	2
23	2	2	2	2
24	2	1	0	0
25	2	2	2	2
26	2	2	2	2
27	2	1	1	2
28	2	2	2	2
Total (out of 14)	14	12	11	12
Actions 29–30				
29	1	1	2	1
30	1	1	1	0
Total (out of 4)	2	2	3	1
Action 31				
31	2	2	2	0
Total (out of 2)	2	2	2	0

(*continued*)

Appendix 3. (*Continued*).

Actions 32–35				
32	2	2	2	0
33	1	2	1	0
34	0	0	0	0
35	1	2	1	0
Total (out of 8)	4	6	4	0